# Reciprocating Engine Gensets in Distributed Generation Applications

## State-of-the-Art Development Building Blocks Enabling Technologies

Presented by

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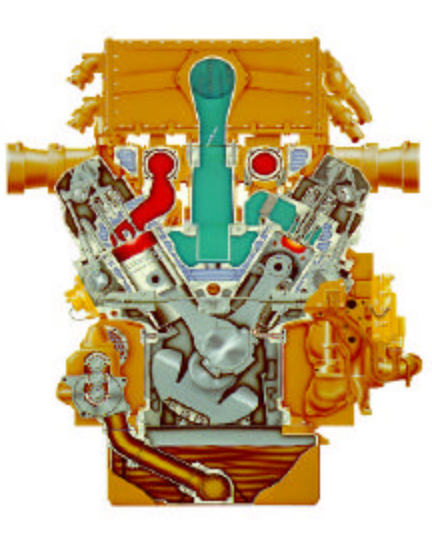
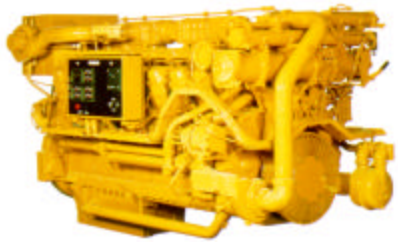


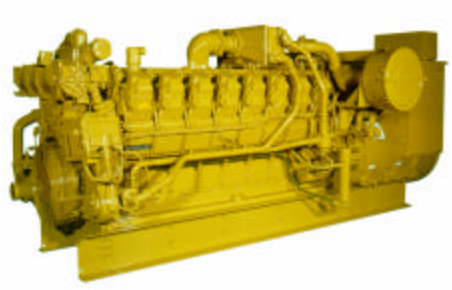
# Agenda

- Current Products
- Getting to ARICE goals
- Technical challenges
- Summary

# Current Products (500ekw+)
# 60 Hz Power Generation



- Diesel Power Range 1000 - 7500 ekW
  - NOx Emissions 5 -12 g/bhp-hr
  - Electrical Efficiencies 34 - 44%



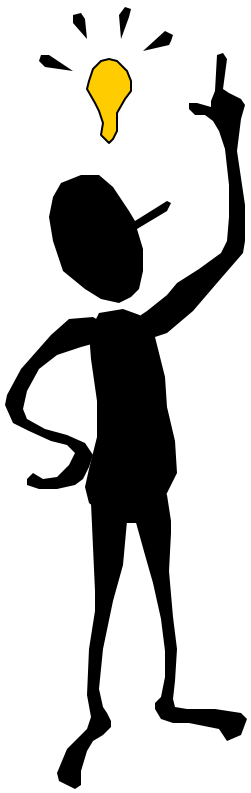
- Gas Power Range 500 - 6000 ekw
  - NOx Emissions 0.5 - 1 g/bhp-hr
  - Electrical Efficiencies 35 - 43%

**A far cry from ARICE <0.1 g/bhp-hr**
**>50% efficiency**

# How Do We Get To ARICE?

- Increased Loads
- Higher Component Efficiencies
- Reduced Friction
- Heat Recovery to Power - Turbocompounding
- Exhaust Aftertreatment
- Improved Controls
- In-cylinder NOx Control Techniques
- Increased Efficiency Generators

# What Technologies Do We Need?



- Increased Loads
  - In-cylinder combustion feedback
  - Knock mitigation
  - Increased pressure ratio turbochargers
- Higher Component Efficiencies
  - Increased efficiency cooling systems for pumps, fans, and aftercoolers
  - Increased efficiency turbochargers
- Lower Friction
  - Low friction lubricants
  - Low friction coatings / surface geometries

# What Technologies Do We Need?

- Heat Recovery to Power - Turbocompounding
  - High temperature materials for valves and manifolds
  - Improved insulation techniques
- Exhaust Aftertreatment
  - Low temp capable catalysts
  - Low sulfur diesel fuels
- Improved Controls
  - Robust and low cost NOx sensors
  - Adaptive control strategies

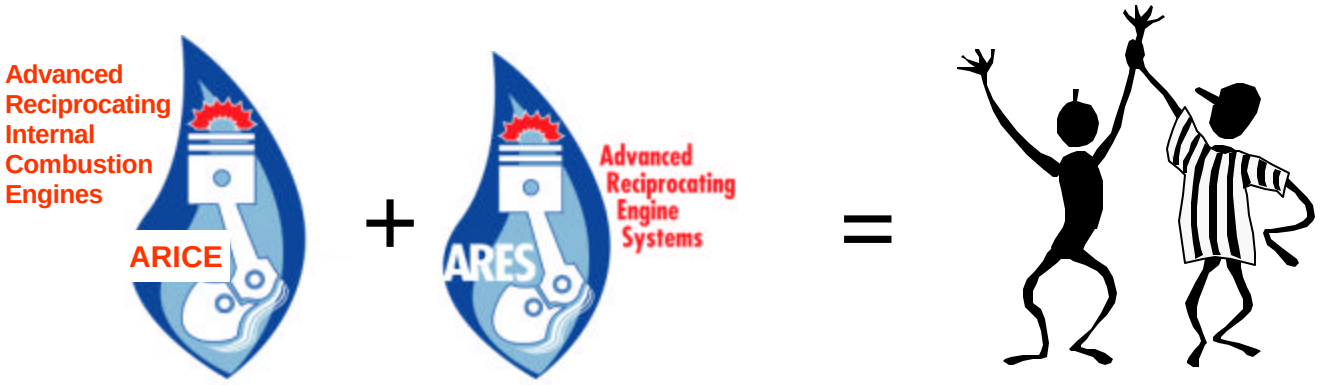
# What Technologies Do We Need?

- In-cylinder NOx Control Techniques
  - Water injection technology
  - EGR pumps, heat exchangers, controls
- Increased  Efficiency Generators
  - Highly efficient synchronous generators
  - Variable speed generators
  - Power control electronics

# Where do we Go?

- Multiple Technical Paths to Investigate
- Clear Commercial Need for Improved Recip Products
- Strong Lab / University / Industry / Government Drive to Succeed

- We Need a Coordinated Approach !!
  - ARICE and ARES Programs

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